

In the Claims:

A complete listing of all of the claims in the present Application is as follows:

1. (Previously Presented) A force provider comprising:

a provider housing that defines a piston chamber, the provider housing including a first beam aperture, a first cylinder aperture that is in fluid communication with a fluid at a first pressure and a spaced apart second cylinder aperture that is in fluid communication with a fluid that is approximately at the first pressure; and

a piston assembly including a piston positioned in the piston chamber, and a first beam extending through the first beam aperture, the piston including a first piston side and a second piston side, the first beam being secured to the first piston side, the piston moving relative to the provider housing along a piston path, wherein at a first piston region of the piston path, the piston is positioned between the first beam aperture and the first cylinder aperture and the second piston side is closer than the first piston side to the first cylinder aperture and the second cylinder aperture, and wherein at a second piston region of the piston path, the piston is positioned between the cylinder apertures.

2. (Original) The force provider of claim 1 wherein the provider housing includes a second beam aperture, the piston assembly includes a second beam extending through the second beam aperture, the second beam being secured to the second piston side.

3. (Original) The force provider of claim 1 wherein at the first piston region, the pressure of the fluid on the first piston side is greater than the pressure of the fluid on the second piston side.

4. (Original) The force provider of claim 3 wherein at the second piston region, the pressure of the fluid on the first piston side is approximately equal to the pressure of the fluid on the second piston side.

5. (Original) The force provider of claim 4 wherein at a third piston region of the piston path, the pressure of the fluid on the second piston side is greater than the pressure of the fluid on the first piston side.

6. (Original) The force provider of claim 5, wherein in the third piston region, the piston is positioned between the second cylinder aperture and a second beam aperture in the provider housing.

7. (Original) The force provider of claim 1 wherein at the second piston region, the pressure of the fluid on the first piston side is approximately equal to the pressure of the fluid on the second piston side.

8. (Original) The force provider of claim 1 wherein at a third piston region of the piston path, the pressure of the fluid on the second piston side is greater than the pressure of the fluid on the first piston side.

9. (Original) The force provider of claim 8, wherein in the third piston region, the piston is positioned between the second cylinder aperture and a second beam aperture in the provider housing.

10. (Original) The force provider of claim 1 wherein a wall gap exists between the piston and the provider housing so that the piston moves easily relative to the provider housing.

11. (Original) A force provider assembly comprising the force provider of claim 1 and a fluid source that directs a fluid into the piston chamber near the first piston region.

12. (Original) The force provider assembly of claim 11 wherein the amount of fluid directed into the piston chamber by the fluid source is approximately equal to the amount of fluid that escapes between the piston and the provider housing and between the first beam and the provider housing.

13. (Original) The force provider assembly of claim 12 wherein the fluid source directs fluid into the piston chamber so that the pressure on the first piston side does not decrease when the piston is moving in a first direction in the first piston region.

14. (Original) The force provider of claim 1 further comprising an intermediate piston positioned within the piston chamber, the intermediate piston moving concurrently with the piston when the piston is positioned in the first piston region and wherein the piston moves relative to the intermediate piston when the piston is positioned in the second piston region.

15. (Original) The force provider of claim 14 wherein the piston is not fixedly coupled to the intermediate piston.

16. (Original) The force provider of claim 14 wherein the first bar extends through the intermediate piston.

17. (Original) A stage assembly for moving a device along a stage path that includes a first stage region and a second stage region, the stage assembly comprising:

a stage that retains the device;

a mover that moves the stage along the stage path; and

the force provider of claim 1 coupled to the stage.

18. (Original) The stage assembly of claim 17 wherein the force provider provides an acceleration/deceleration force on the stage when the stage is in the first stage region and approximately no force on the stage when the stage is in the second stage region.

19. (Original) The stage assembly of claim 18 wherein the stage path includes a third stage region and the force provider provides an acceleration/deceleration force on the stage when the stage is in the third stage region.

20. (Original) An exposure apparatus including the stage assembly of claim 17.

21. (Original) An object on which an image has been formed by the exposure apparatus of claim 20.

22. (Original) A semiconductor wafer on which an image has been formed by the exposure apparatus of claim 20.

23. (Currently Amended) A combination comprising:

a mover that moves a stage along a ~~stage-path~~ first axis that includes a first stage region and a second stage region; and

a force provider assembly including a pneumatic force provider coupled to the stage, the force provider providing an acceleration/deceleration force on the stage along the ~~stage-path~~ first axis when the stage is in the first stage region and approximately no force on the stage when the stage is in the second stage region.

24. (Currently Amended) The combination of claim 23 wherein the ~~stage-path~~ first axis includes a third stage region and the force provider provides an acceleration/deceleration force on the stage when the stage is in the third stage region.

25. (Previously Presented) The combination of claim 23 wherein the force provider comprises (i) a provider housing that defines a piston chamber, the provider housing including a first beam aperture, a first cylinder aperture that is in fluid communication with a fluid at a first pressure and a spaced apart second cylinder aperture that is in fluid communication with a fluid at approximately the first pressure; and (ii) a piston assembly including a piston positioned in the piston chamber, and a first beam extending through the first beam aperture, the piston including a first piston side and a second piston side, the first beam being secured to the first piston side, the piston moving relative to the provider housing along a piston path, wherein at a first piston region of the piston path, the piston is positioned between the first beam aperture and the first cylinder aperture and at a second piston region of the piston path, the piston is positioned between the cylinder apertures.

26. (Previously Presented) The combination of claim 23 wherein the force provider comprises (i) a provider housing that defines a piston chamber, the provider housing including a first beam aperture, a second beam aperture, a first cylinder aperture that is in fluid communication with a fluid at a first pressure and a spaced apart second cylinder aperture that is in fluid communication with a fluid at approximately the first pressure; and (ii) a piston assembly including a piston positioned in the piston chamber, a first beam extending through the first beam aperture and a second beam extending through the second beam aperture, the piston including a first piston side and a second piston side, the first beam being secured to the first piston side and the second beam being secured to second piston side, the piston moving relative to the provider housing along a piston path, wherein at a first piston region of the piston path, the piston is positioned between the first beam aperture and the first cylinder aperture and at a second piston region of the piston path, the piston is positioned between the cylinder apertures.

27. (Previously Presented) The combination of claim 26 wherein at the first piston region, the pressure of the fluid on the first piston side is greater than the pressure of the fluid on the second piston side.

28. (Previously Presented) The combination of claim 27 wherein at the second piston region, the pressure of the fluid on the first piston side is approximately equal to the pressure of the fluid on the second piston side.

29. (Previously Presented) The combination of claim 27 wherein at a third piston region of the piston path, the pressure of the fluid on the second piston side is greater than the pressure of the fluid on the first piston side.

30. (Previously Presented) The combination of claim 29, wherein in the third piston region, the piston is positioned between the second cylinder aperture and the second beam aperture.

31. (Previously Presented) The combination of claim 26 wherein a wall gap exists between the piston and the provider housing so that the piston moves easily relative to the provider housing.

32. (Previously Presented) The combination of claim 26 further comprising a fluid source that directs a fluid into the piston chamber near the first piston region.

33. (Previously Presented) The combination of claim 32 wherein the amount of fluid directed into the piston chamber by the fluid source is approximately equal to the amount of fluid that escapes between the piston and the provider housing and between the first beam and the provider housing.

34. (Previously Presented) The combination of claim 32 wherein the fluid source directs fluid into the piston chamber so that the pressure on the first piston side does not decrease when the piston is moving in a first direction in the first piston region.

35. (Previously Presented) The combination of claim 23 wherein the force provider further comprises a provider housing that defines a piston chamber, a piston positioned within the piston chamber and an intermediate piston positioned within the piston chamber, the intermediate piston moving concurrently with the piston when the stage is positioned in the first stage region and wherein the piston moves relative to the intermediate piston when the stage is positioned in the second stage region.

36. (Previously Presented) The combination of claim 35 wherein the piston is not fixedly coupled to the intermediate piston.

37. (Previously Presented) A stage assembly for moving a device, the stage assembly comprising:

a stage that retains the device; and
the combination of claim 23 coupled to the stage.

38. (Original) An exposure apparatus including the stage assembly of claim 37.

39. (Original) An object on which an image has been formed by the exposure apparatus of claim 38.

40. (Original) A semiconductor wafer on which an image has been formed by the exposure apparatus of claim 38.

41. (Previously Presented) A force provider comprising:

a provider housing that defines a piston chamber; and
a piston assembly including a piston and a first intermediate piston positioned within the piston chamber, the piston moving relative to the provider housing along a piston path that includes a first piston region and a second piston region, wherein the first intermediate piston moves concurrently with the piston when the piston is positioned in at least a portion of the first piston region and wherein the piston moves independently of the first intermediate piston when the piston is positioned in the second piston region so as to change the distance between the piston and the first intermediate piston.

42. (Original) The force provider of claim 41 wherein the piston is not fixedly coupled to the first intermediate piston.

43. (Original) The force provider of claim 41 further comprising a first bar that is secured to the piston, the first bar extending through the first intermediate piston and through the provider housing.

44. (Canceled)

45. (Canceled)

46. (Original) The force provider of claim 41 wherein (i) the piston assembly includes a second intermediate piston that is positioned within the piston chamber, (ii) the piston path includes a second piston region, (iii) the second intermediate piston moves concurrently with the piston when the piston is positioned in at least a portion of the third piston region, and (iv) the piston moves relative to the second intermediate piston when the piston is positioned in the first piston region and the second piston region.

47. (Original) The force provider of claim 41 wherein the provider housing includes a first beam aperture, a first cylinder aperture that is in fluid communication with a fluid at a first pressure and a spaced apart second cylinder aperture that is in fluid communication with a fluid that is approximately at the first pressure, and wherein the piston assembly includes a first beam extending through the first beam aperture, the piston including a first piston side and a second piston side, the first beam being secured to the first piston side, wherein at the first piston region of the piston path, the piston is positioned between the first beam aperture and the first cylinder aperture and at the second piston region of the piston path, the piston is positioned between the cylinder apertures.

48. (Original) The force provider of claim 47 wherein at the first piston region, the pressure of the fluid on the first piston side is greater than the pressure of the fluid on the second piston side.

49. (Original) The force provider of claim 48 wherein at the second piston region, the pressure of the fluid on the first piston side is approximately equal to the pressure of the fluid on the second piston side.

50. (Original) The force provider of claim 49 wherein at a third piston region of the piston path, the pressure of the fluid on the second piston side is greater than the pressure of the fluid on the first piston side.

51. (Original) The force provider of claim 50, wherein in the third piston region, the piston is positioned between the second cylinder aperture and a second beam aperture in the provider housing.

52. (Original) The force provider of claim 41 wherein a wall gap exists between the piston and the provider housing so that the piston moves easily relative to the provider housing.

53. (Original) A stage assembly for moving a device along a stage path that includes a first stage region and a second stage region, the stage assembly comprising:
a stage that retains the device;
a mover that moves the stage along the stage path; and
the force provider of claim 41 coupled to the stage.

54. (Original) The stage assembly of claim 53 wherein the force provider provides an acceleration/deceleration force on the stage when the stage is in the first stage region and approximately no force on the stage when the stage is in the second stage region.

55. (Original) The stage assembly of claim 54 wherein the stage path includes a third stage region and the force provider provides an acceleration/deceleration force on the stage when the stage is in the third stage region.

56. (Original) An exposure apparatus including the stage assembly of claim 53.

57. (Original) An object on which an image has been formed by the exposure apparatus of claim 56.

58. (Original) A semiconductor wafer on which an image has been formed by the exposure apparatus of claim 56.

59. (Currently Amended) A method for accelerating and decelerating a stage, the method comprising the steps of:

coupling a mover to the stage that moves the stage along a ~~stage-path~~ first axis that includes a first stage region and a second stage region; and

coupling a pneumatic force provider to the stage, the force provider providing an acceleration/deceleration force on the stage along the ~~stage-path~~ first axis when the stage is in the first stage region and approximately no force on the stage when the stage is in the second stage region.

60. (Currently Amended) The method of claim 59 wherein the ~~stage-path~~ first axis includes a third stage region and the force provider provides an acceleration/deceleration force on the stage when the stage is in the third stage region.

61. (Previously Presented) The method of claim 59 wherein the step of coupling includes the step of providing a force provider that comprises (i) a provider housing that defines a piston chamber, the provider housing including a first beam aperture, a first cylinder aperture that is in fluid communication with a fluid at a first pressure and a spaced apart second cylinder aperture that is in fluid communication with a fluid at approximately the first pressure; and (ii) a piston assembly including a piston positioned in the piston chamber, and a first beam extending through the first beam aperture, the piston including a first piston side and a second piston side, the first beam being secured to the first piston side, the piston moving relative to the provider housing along a piston path, wherein at a first piston region of the piston path, the piston is positioned between the first beam aperture and the first cylinder aperture and at a second piston region of the piston path, the piston is positioned between the cylinder apertures.

62. (Previously Presented) The method of claim 59 wherein the step of coupling includes the step of providing a force provider that comprises (i) a provider housing that defines a piston chamber, the provider housing including a first beam aperture, a second beam aperture, a first cylinder aperture that is in fluid communication with a fluid at a first pressure and a spaced apart second cylinder aperture that is in fluid communication with a fluid at approximately the first pressure; and (ii) a piston assembly including a piston positioned in the piston chamber, a first beam extending through the first beam aperture and a second beam extending through the second beam aperture, the piston including a first piston side and a second piston side, the first beam being secured to the first piston side and the second beam being secured to second piston side, the piston moving relative to the provider housing along a piston path, wherein at a first piston region of the piston path, the piston is positioned between the first beam aperture and the first cylinder aperture and at a second piston region of the piston path, the piston is positioned between the cylinder apertures.

63. (Original) The method of claim 61 wherein at the first piston region, the pressure of the fluid on the first piston side is greater than the pressure of the fluid on the second piston side.

64. (Original) The method of claim 63 wherein at the second piston region, the pressure of the fluid on the first piston side is equal to the pressure of the fluid on the second piston side.

65. (Original) The method of claim 64 wherein at a third piston region of the piston path, the pressure of the fluid on the second piston side is greater than the pressure of the fluid on the first piston side.

66. (Original) The method of claim 65, wherein in the third piston region, the piston is positioned between the second cylinder aperture and the second beam aperture.

67. (Original) The method of claim 62 further comprising the step of directing a fluid from a fluid source into the piston chamber near the first piston region.

68. (Canceled)

69. (Original) The method of claim 59 wherein the step of coupling includes the step of providing a force provider that comprises (i) a provider housing that defines a piston chamber; and (ii) a piston assembly including a piston and a first intermediate piston positioned within the piston chamber, the piston moving relative to the provider housing along a piston path that includes a first piston region and a second piston region, wherein the first intermediate piston moves concurrently with the piston when the piston is positioned in at least a portion of the first piston region, and wherein the piston moves relative to the first intermediate piston when the piston is positioned in the second piston region.

70. (Original) The method of claim 69 wherein the piston is not fixedly coupled to the first intermediate piston.

71. (Original) A method for making an exposure apparatus comprising the steps of providing an illumination source, providing a stage, and accelerating and decelerating the stage by the method of claim 59.

72. (Original) A method of making a wafer including the steps of providing a substrate and forming an image on the substrate with the exposure apparatus made by the method of claim 71.

73. (Previously Presented) A force provider comprising:

a provider housing that defines a piston chamber; and

a piston assembly including a piston and a first intermediate piston positioned within the piston chamber, a first bar that is secured to the piston, the first bar extending through the first intermediate piston and through the provider housing, and a first intermediate bar that is secured to the first intermediate piston, the first intermediate bar extending through the provider housing, the piston moving relative to the provider housing along a piston path that includes a first piston region and a second piston region, wherein the first intermediate piston moves concurrently with the piston when the piston is positioned in at least a portion of the first piston region and wherein the piston moves relative to the first intermediate piston when the piston is positioned in the second piston region.

74. (Previously Presented) The force provider of claim 73 wherein the first bar extends through the first intermediate bar.

75. (New) A combination comprising:

a mover that moves a stage along a first axis that includes a first stage region and a second stage region; and

a force provider assembly including a pneumatic force provider coupled to the stage, the force provider providing an acceleration/deceleration force on the stage when the stage is moving along the first axis in the first stage region and approximately no force on the stage when the stage is moving along the first axis in the second stage region.

76. (New) The combination of claim 75 wherein the force provider provides the acceleration/deceleration force on the stage along the first axis when the stage is in the first stage region.

77. (New) The combination of claim 75 wherein the force provider comprises (i) a provider housing that defines a piston chamber, the provider housing including a first beam aperture, a first cylinder aperture that is in fluid communication with a fluid at a first pressure and a spaced apart second cylinder aperture that is in fluid communication with a fluid at approximately the first pressure; and (ii) a piston assembly including a piston positioned in the piston chamber, and a first beam extending through the first beam aperture, the piston including a first piston side and a second piston side, the first beam being secured to the first piston side, the piston moving relative to the provider housing along a piston path, wherein at a first piston region of the piston path, the piston is positioned between the first beam aperture and the first cylinder aperture and at a second piston region of the piston path, the piston is positioned between the cylinder apertures.